Kunio MITUI*: Cytological and taxonomical studies on ferns (2) *Dryopteris lacera* and *D. uniformis*

三井邦男*: シダ類の細胞学, 分類学的研究 (2)

D. lacera O. Kuntze and *D. uniformis* Makino are very common in Japan. The morphological characters of these two species are very similar and they have common habitats. Many taxonomists distinguish them by (1) the position of the sori on the fronds, (2) the shape of the soriferous pinnulus, (3) the color of the scales, and (4) the appearance of the veins. Cytologically Kurita (1960, 1966) and Hirabayashi (1966) reported n=41 for *D. lacera* and n=82 for *D. uniformis*. The present paper is the result of my study on the morphology and cytology on these two species. I wish to express my sincere appreciation to Prof. H. Ito for his kind advice during the study.

Materials were collected from two localities: Kiyosumi, Tiba Pref. and Hasimoto, Kanagawa Pref. Methods are same in the previous paper (1966). Twenty four specimens were able to be divided into three groups according to their chromosome numbers. The first group (A) had haploid chromosome number 41 and its meiosis was normal (fig. 2, A). The second (C) had haploid chromosome number 82 (fig. 2, C) and also the meiosis was normal. The third (B) had approximately 41 pairs and 41 single chromosomes at diakinesis stage (fig. 2, B) and the meiosis was irregular contrary to the former two groups. Tab. 1 shows the morphological differences among these groups.

Discussion and conclusion From tab. 1, the group A (n=41) is obviously *D. lacera* and the group C (n=82) is *D. uniformis*. On the other hand, it seems that the characters of the group B are intermediate between groups A and C. Additionally these specimens show approximately 41 pairs and 41 single chromosomes at first meiotic metaphase and their distribution were irregular. Accordingly, the formation of spores is not successful and the spores should be sterile (fig. 2, E). Considering these cytological and morphological evidences, I think that the group B must be a hybrid between group A (*D. lacera*) and group C (*D. uniformis*). The intermediate form between groups A and C in the field may be considered as this group B. The group B was described as *D. lacera* form. *intermedia*

* Botanical Institute, Faculty of Science, Tokyo University of Education, Tokyo. 東京教育大学理学部植物学教室

by Prof. H. Ito (1936). As mentioned above this hybrid (*D. lacera*×*D. uniformis*) shows 41 bivalents and 41 univalents at meiosis and this evidence points that *D. lacera* and *D. uniformis* share a common genome. However, *D. uniformis* is an tetraploid and it is unknown if this is an autotetraploid or an allotetraploid. If *D. uniformis* is an allotetraploid having *D. lacera* as one of the parents, there

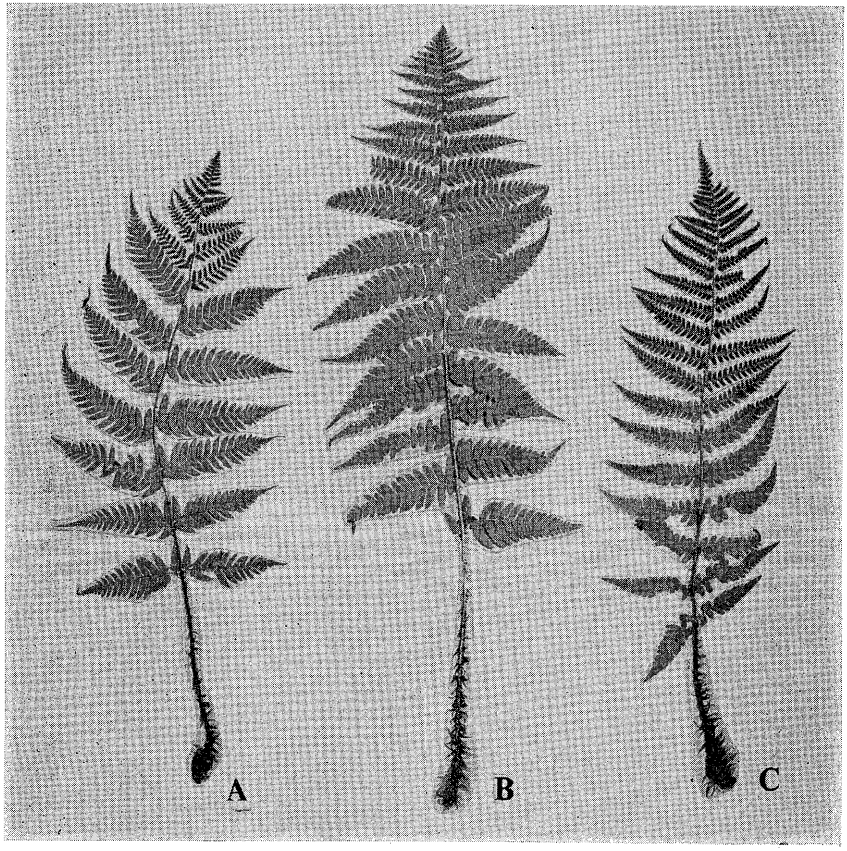

Fig. 1. A. *Dryopteris lacera*. B. *D. lacera* form. *intermedia*. C. *D. uniformis*.

must be more qualitative difference between *D. uniformis* and *D. lacera*. On the other hand, *D. uniformis* must have the characteristics of an autotetraploid of *D. lacera*, if *D. uniformis* is an autotetraploid. In the previous paper (Mitui, 1966) I reported the comparison of morphological characteristics in the diploid race and its autotetraploid in *Lepisorus thunbergianus* and *Phegopteris decursivepinnata*.

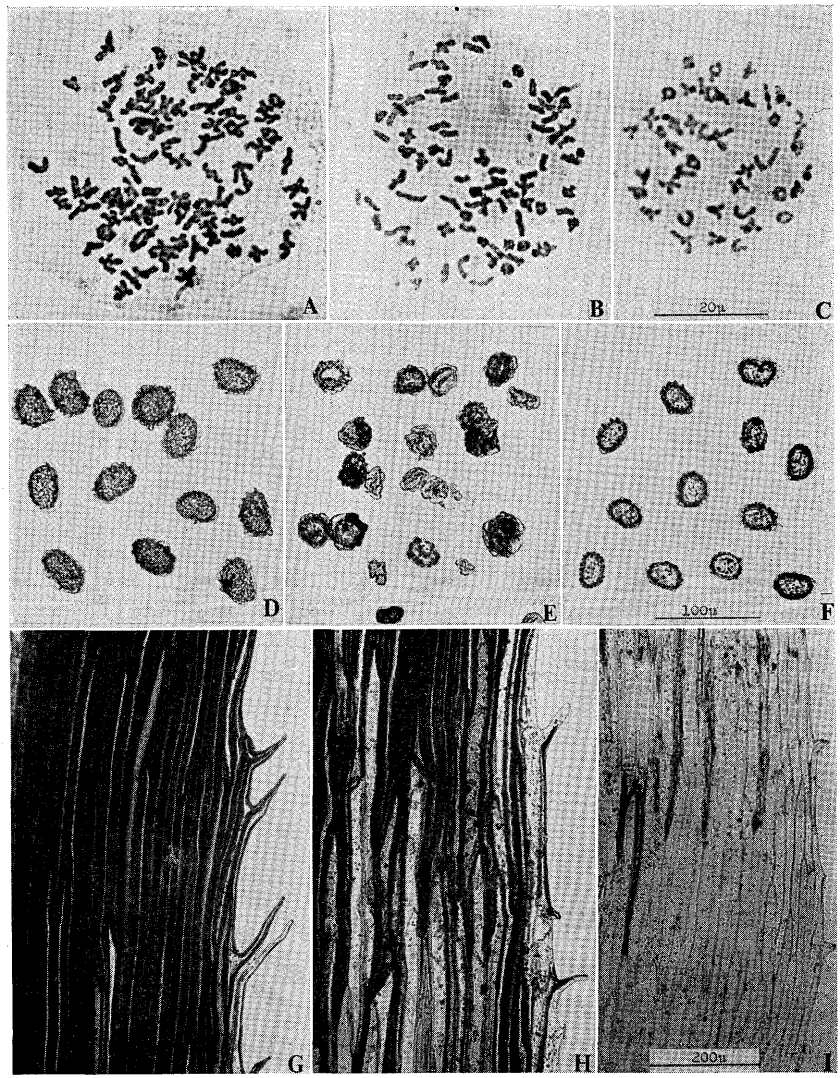

Fig. 2. A—C. Meiosis. D—F. Spores. G—H. Scales on rachis. A, D, G. *Dryopteris lacera*. B, E, I. *D. lacera* form. *intermedia*. C, F, H. *D. uniformis*.

In both species, stomata and spore size of the tetraploids are larger than those of the diploids. Furthermore, in the tetraploids of *L. thunbergianus* the sclerenchyma tissues of scales grow in greater extent than in the diploids. As shown in tab.

1, it is apparent the that morphological differences are almost quantitative in both species (*D. lacera* and *D. uniformis*), and the tetraploid shows the gigas habitus. In the tetraploid species, sizes of spores and stomata are larger and the fertile parts of lamina are longer and the cell walls in scales are more thickened than in those of the diploid species. Further, Momose (1938) reported that in *D. uniformis*, the antheridia and the cell of gametophyte are larger than those of the other species. The exact karyotype analysis must be necessary to decide that *D. uniformis* should be an autotetraploid derived from *D. lacera*, but the above mentioned evidences may be enough for this opinion. The hybrid between *D. uniformis* and *D. lacera* is an autotriploid and these compose an autopolyploid series. In other words, these are identical in their genes and the difference is only quantitative. Accordingly, morphological features in these taxa might be depend on the difference of chromosome number. For example the scale of rachis is very thin membranaceous one without any thickening of cell walls and has no or only little bristles at the margin in the diploid (fig. 2. G). However, that of the triploid is membranaceous with thickening of cell walls in good extent and has bristles at the margin (fig. 2. H). On the other hand, that of the tetraploid is filled up completely with thick cell walls, and has long or dichotomously branched bristles at the margin (fig. 2. I). It has been recognized that autopolyploidy does not lead the formation of new species, but it should be limited to only varieties. In fact, in *Lepisorus thunbergianus* and *Phegopteris decursivepinnata* it is difficult to distinguish tetraploids from diploids only by the external characters. However, it is easy to distinguish *D. lacera* from *D. uniformis*, as we can find the intermediate type. Therefore, it can be concluded that autopolyploidy is basically important for the speciation.

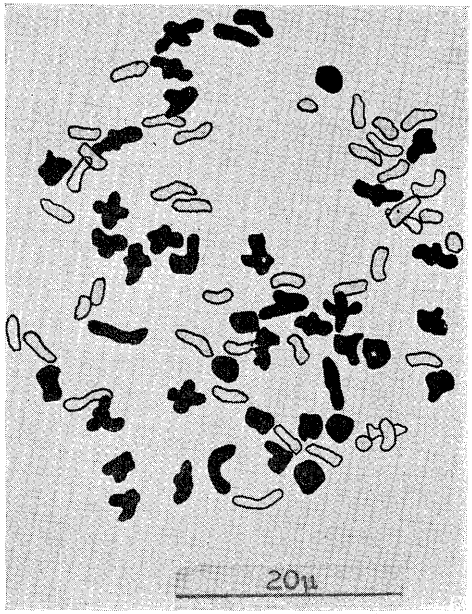

Fig. 3. Explanatory diagram to fig. 2, B.

Tab. 1. The contrast of some characters of three groups

Characters \ Groups	A (n=41) 10 specimens	B $\left(n=\frac{123}{2}\right)$ 3 specimens	C (n=82) 11 specimens
Reproduction	sexual	unknown	sexual
Spore	normal	abortive	normal
Spore size	35.6μ	irregular	44.8μ
Stomata size	49.3μ	53.5μ	58.3μ
Length of stipe	13–25 cm	25–33 cm	13–27 cm
Length of lamina (L)	31–57 cm	49–58 cm	37–65 cm
Length of fertile part of lamina (F)	10–24 cm	22–33 cm	15–36 cm
L/F (mean)	2.3–(2.8)–3.3	1.7–(1.8)–2.2	1.3–(1.6)–2.4
Fertile part of lamina	shrink	not shrink	not shrink
Degree of cell wall thickness	+	++	+++
Bristle of scales on rachis	small or nothing	long	very long
Vein sinking	++	+	0
Color of scales on stipe	pale brown	pale brown to blackish brown	pale brown to blackish brown

References

Hirabayashi, H. 1966. Journ. Jap. Bot. **41**: 11–13. Ito, H. 1939. Nova Flora Japonica **4**: 1–243. Kurita, S. 1960. Journ. Jap. Bot. **35**: 269–272. ——— 1962. Journ. Coll. Chiba Univ. **3**: 463–468. Lovis, J. D. 1964. Nature **203**: 324–325. Mitui, K. 1966. Journ. Jap. Bot. **41**: 270–276. Momose, S. 1938. Journ. Jap. Bot. **14**: 445–453. Tryon, R. & D. M. Britton 1966. Rhodora **68**: 59–92.

* * * *

クマワラビ，オクマワラビに属する 24 株を染色体数で分類してみた。その結果，三つのグループに分けられた。2 倍体（クマワラビ），4 倍体（オクマワラビ），3 倍体（アイノコクマワラビ）である。オクマワラビの胞子と気孔はクマワラビのものに較べて大きく，両者の雑種と思われるアイノコクマワラビの減数分裂で 41 個の一価と同数の二価染色体があらわれることから，オクマワラビはクマワラビから由来した同質四倍体と考えられる。それゆえこれらの分類群は同質倍数性の関係にあると思われる。これら三つのグループの形態的差異は中肋のりん片の色ととげによくあらわれる。